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Metabolism as a Connecting Link between Dental Surgery and General Medicine.

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(Read before the Pennsylvania State Dental Society, at its thirty-eighth annual meeting, Philadelphia, Pa., June 26, 1906; reprinted from the DENTAL COSMOS for November 1906.)

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THE current literature of any profession reflects the status of that profession. The researches of the most active minds engaged in the practice of that profession, and the vital questions of the hour attracting their thought and attention, are here recorded. To this record, as to a gage, one at any stage may turn and learn of the degrees of professional progress. What Dentistry was, what it is, and in a measure what it will become, may therefore thus be definitely traced.

Not to him who reads of the present only, but rather to the thoughtful mind taking a comprehensive review, is the interesting picture of its evolution revealed. Seventy years ago dental surgery proposed to begin as a specialty of general medicine, for the thought presented itself to the few intelligent men then engaged in operations upon the teeth that the care of these organs was worthy of the attention of medicine, and overtures were made by them to the medical faculty to give dentistry consideration. The idea, however, was in advance of the age, and the relationship was not apparent to the medical profession. Today dental surgery does not stand asking this incorporation, for the then divergent line has by the force of its own evolution become so convergent that, without any desire by the one party or acceptance by the other, this most peculiar and far-reaching specialty of medicine will in the near future be accepted as such by the world without specific thought or attention to the fact.

The forces producing this condition are many and various, and lie scattered all along the converging line. Two of them perhaps stand out more markedly than the rest, one strictly surgical and the other strictly medical. The orthopedic treatment of the face as embodied in orthodontia is the surgical factor, and the medical factor is to be found in the diseases of metabolism.

Before entering into any consideration of metabolism and its intricate and interesting relationships to dental surgery as developing in general medicine, let us in our minds go back to about the year 1835, when dentistry entered upon its

career as dental surgery, and in concise review look over the evolution which makes it important to note that dentistry today is not composed of two-thirds manual training and one-third surgical science, but includes the wide medical knowledge so necessary to treat diseases consecutive to disturbances of the teeth, viz, diseases of the gums, of the jaws, of the maxillary sinuses, etc. This evolution necessarily creates a division into technical dentistry, surgical dentistry, and medical dentistry.

Recognizing that men deserving well of the republic of letters, even though not educated in a medical college, yet being learned in the discipline of good arts from another source, should be distinguished from others by a conferred title, the degree of Doctor of Dental Surgery was deemed proper, because relief from the distress of "decayed" teeth was to be had by extraction, and this removal was surgical in its nature. Further, relief under certain conditions was given by filling the cavity of decay, and this being a mechanical procedure was surgical in its nature. A demand was created, by the loss of teeth, for their artificial replacement, and the making and insertion of appliances for this purpose seemed to be surgical also. For cosmetic effect an irregular tooth was occasionally drawn into better position, and this too was of the nature of surgical intervention. Dentistry was thus naturally branded "dental surgery," and the literature of the new profession dealt with the daily conditions of its practice—the methods of making artificial dentures, the procedures involved in extraction, the medicaments for the relief of toothache, the questions of tooth-stoppings, the qualities of soft or adhesive gold, amalgams, gutta-percha, cements. No wonder the medical profession saw little of their own methods, either medical or surgical, involved in all this.

Slowly but surely through the years devoted to these things a new era was developing, and as a knowledge of anatomy and physiology was attained, a constant undercurrent of thought was working out something better and higher. In due course it came about that a tooth was not simply to be filled, but it needed to be filled with due consideration of its chemic relationships and with attention to its occlusal and approximal shapes; its functional purpose must be retained or restored. Artificial teeth were not to be inserted into mouths as simple replacements, but they must restore the functional purposes of teeth. Cosmetic effects were no longer the only motive for the treatment of irregular teeth. The secrets of occlusal relationship are studied and the intentions of nature along full functional lines recognized, and these must fully be met in the treatment given. Dentistry then was truly becoming surgical.

A little farther on, the domains of the rhinologist and the laryngologist are touched and overlapped. Bacteriology is studied, and later, as a fitting outcome of this development, a jump is taken as it were into the future, and dental prophylaxis becomes the watchword of the present hour, not only of the dental surgeon but also of the general surgeon; another overlapping. Functional restoration in every direction having been obtained, functional activity is to be maintained.

Prevention, the brightest star in the medical circlet of today, shines, too, in the diadem of dentistry, and the highest pinnacle would seem to have been reached were it not that, as dentistry has developed, civilization has also at the same time engrafted a strenuous life upon the people. Systemic disturbances have resulted which have such dental and oral manifestations as to demand the attention of the dentist as well as of the practitioner of general medicine. Peculiar as it may be, these are not truly diseases of dental origin requiring general medical treatment, but medical diseases with dental and oral manifestations—diseases which proclaim in the oral cavity, unseen by the physician, often very far in advance of any knowledge by the patient or of any other notable signs of their presence, a tocsin of warning to be recognized by the dentist and demanding treatment at his hands. The practitioner of dental surgery is thus now

forced over into the domain of general medicine.

The diseases referred to center in and around metabolism. The dentist must today comprehend the influence of the trophic nerves and the questions of normal secretion and excretion, the maintenance of a proper balance between waste and repair, the influences of the blood, its composition, and the disturbances of its circulation. Hepatic and renal conditions must be considered. Analyses of saliva and urine must be made and interpreted. At the end of seventy years of such evolutionary progress the medical faculty is welcoming its brothers in the healing art with open arms, and no longer looks askance, for dentistry has demonstrated that it is a specialty of medicine; a peculiar specialty it may be and is, but now not strictly surgical, and the day is at hand when the term dental surgeon must give way and be replaced by stomatologist, as indicative of one who treats his cases with the broadest culture. Dental colleges will then have added to the present curriculum by training students in such general medicine as has been outlined.

When this climax occurs, the propriety of the present attempt to divide dentistry into specialties may be questioned and may call for readjustment, for a specialty of a specialty would be somewhat incongruous! All such division undoubtedly develops technique, but this development of technique has already given evidence of a tendency to produce a narrower field of vision—by which, not infrequently, in the accomplishment of a particular purpose, are deranged the organic functions of the oral cavity.

The technique of crowns, bridges, artificial dentures, and appliances of orthodontia must surely continue, for they are necessities, and consequently will continue to segregate artisans to produce them. However, this issue may safely be left to the control of that same evolutionary force which has already done so much for our uplifting, and which undoubtedly will prove abundantly potent to properly regulate the matter.

I have allowed myself this considerable liberty in approaching what I may say touching *metabolism,* for the reason that I wanted to bring you, as it were, into the atmosphere of the thought which led me to choose the topic for our consideration at this time. The diseases of metabolism are at our door, and it is not a theory but an actual condition which confronts us, and the evolution of our existence asks us to measure up to the occasion. It is well, therefore, to recognize the topic as intensely practical and not theoretical, and to search the accumulated experience of others as presented by medical writers, to the gaining of a condensed yet comprehensive knowledge which shall enable us to deal wisely and successfully with these diseases.

The study of metabolism is the study of an intricate and important subject. The term indicates the changes occurring when living organisms by inherent functional power take substances derived from food into their tissues and make them a part of themselves—an uplifting by which living material vitalizes crude nutritive material, or increases molecular complexity: anabolism. It further has to deal with the removal of broken-down material, waste material the result of this nutritional process—a change in the opposite direction, decreasing molecular complexity: catabolism. In two words: assimilation, excretion.

The study of the individual is really the study of the cell, and the assimilative and dissimilative changes taken together are nutrition—metabolism. Food decomposition does not take place in the blood and fluids, but in the tissues, where the decomposition is brought about by the chemical activity of the cells. The destination of food is the growth and renovation of the component parts of the body and the production of heat and energy. For these purposes the actual seat of utilization is within the protoplasmic or biogenic molecules constituting the basis of living matter. It is here that the active changes of life occur. Food elements on the one hand and oxygen on the other enter the large and highly complex molecules of which protoplasm is composed, and through the play

of changes ensuing, the phenomena of life are evolved. As an outcome of this proposition, the food material has to reach these protoplasmic molecules, and in so doing traverses the circulatory system. Modern research shows that what has to be dealt with is something far otherwise than a simple passage of nutrient chemical principles into the blood at the seat of absorption. Solid matter requires to be brought into a liquid state, and all nutrient principles to be placed in a condition to which the property of diffusibility belongs. This is effected by enzyme action, the enzymes being products of secretion of the digestive system, adjusted by nature to accomplish the purposes required to be fulfilled.

Digestion is the preparation of food for absorption, but ideas regarding what is needed to permit of entry into living protoplasm, and thence of taking part in the metabolic changes occurring, have in recent times undergone great development. Formerly it was considered sufficient to regard digestion as bringing the food into a liquid or diffusible state so as to permit of the occurrence of absorption in compliance with the physical laws of osmosis. The effect of modern research, however, is to show that it is by the instrumentality of cell action instead of by physical osmosis that the products of digestion pass into the system, and absorption may be said to mean bioplasmic incorporation, the absorbed material passing into and becoming a component of living matter—in other words, assimilated. The process of digestion not only reduces the size of molecules to give the property of diffusibility, but also sees that the molecules produced should be of such construction as to be adapted to unite with those into which they are intended to become incorporated. It is the province of the enzymes to bring about this adaptation, and unless it is brought about there can be no combination. This having been effected, the union takes place by virtue of affinity —affinity dependent upon molecular configuration. Under this view of physiologic metabolism, as set forth by Pavy, the food principles are in the first instance constructed by assimilative action into the principles of the blood. The blood feeds upon the food supplied from without, and the tissues feed upon the blood. Among the recognized components of the blood are the corpuscular elements, and these are now found to be more varied than as set forth by the old division into the red and white corpuscles. It is through these elements that the prepared material is taken to the appropriating tissues. Oxygen is taken in by the hemoglobin, and in a state of combination transported to the tissues, where it is taken off and applied to utilization.

When the physiologic procedure the outline of which I have just recited takes place, the organic portions of food, known as nitrogenous and non-nitrogenous, the one being proteid and the other being fats and carbohydrates, become lost to sight after being ingested; on the other hand, when for any reason this process is disturbed, certain conditions result and pathology steps in to account for the disturbance.

It is therefore necessary that the dentist have a clear comprehension of the normal conditions of nutrition, that he may not be led into erroneous interpretations of pathologic conditions; for the knowledge of the one is immediately involved as a basis by which to read correctly the other. He may make local applications again and again without any possibility of curing the case which has come to him for treatment. Nothing but personal mortification and professional stultification can be the result. He can only treat successfully as he is able to pass into the broad domain of pathology, lay his finger upon the disturbing cause, and correct the attendant abnormal condition arising therefrom.

Some of the diseases of the uric acid diathesis perhaps may be taken as a fair illustration of the point asserted, and also as illustrative at the same time of the loose, disjointed training in general medicine evidenced on the part of many of the dentists who in the last decade have essayed to write on this subject. A review of the many articles written and

published in our literature shows a lack of accurate knowledge which has not infrequently led to an unwitting misstatement of fact.

Wm. Henry Porter points out that uric acid is formed normally and solely by a process of oxidation, and that uric acid never exists in foodstuffs, and also that there is no method known to chemistry by which we can logically and accurately assume that the uric acid exists in the blood. The proteid molecule, in its isomeric transition through the system, often reaches the condition in which it is more easily oxidized into a uric acid molecule than into urea. None can deny, however, that an antecedent is not a finished product.

Accepting this theory of oxidation reduction of a certain isomeric form of the proteid molecule in the renal cells, it is easy to explain the presence of uric acid and the formation of urates, together with the production of the insoluble phosphate of calcium urate deposited at various points of the body outside the renal structures. The disturbance of metabolism that is concomitant with this condition results in certain instances in a vicarious action on the part of the various protoplasmic structures throughout the animal economy. As a natural sequence of this vicarious action and imperfect oxidation reduction, uric acid is produced suddenly and unexpectedly at various points in the body. Following this sudden formation of uric acid, there is produced at these local points urates which are either the insoluble phosphate or calcium urate, or both.

To understand fully this instantaneous formation of the urate and the necessity for the production of uric acid in the renal cells, we must at the same time follow the so-called alkaline phosphates in their transit through the system. The normal phosphate of the blood is a neutral salt, and the one in the urine is an acid salt. The presence of the neutral sodium phosphate in the urine tends to hold the uric acid in solution, but at the same time, it favors a deposition of the earthy phosphates, and thus has a tendency to excite the formation of phosphatic calculi. Therefore, it is essential to rid the urine of this salt, and to secure in its place one which will hold the earthy phosphates in solution, destroying the irritating properties of a strong solution of uric acid. The uric acid, as it is formed and discharged from the renal cells, comes in contact with the neutral sodium phosphate, which is constantly escaping from the blood into the uriniferous tubules, with the development of a sodium urate and the formation of the sodium acid phosphate in place of the neutral salt.

The practical aspect of the subject is that an over-production of uric acid is always dependent upon three general principles:

(1) A defective oxygen supply.
(2) Taking into the system more food than can be perfectly oxidized.
(3) Disturbances in the action of the nervous mechanism.

I have given this view of Professor Porter at some length, but I think sufficiently succinctly to clear your minds, and hereafter our papers and discussions, of the idea that uric acid as such exists in the blood.

The process of oxidation as a potent factor in metabolism must not be lost to mind, and it is as necessary for us that the carbonic acid produced as a result of the operations of life should be conveyed from the tissues to the lungs for discharge as that oxygen should be conveyed from the lungs to the tissues. The sodium carbonate and phosphate are the agency mainly affecting the conveyance of carbonic acid to the lungs for its discharge. The appropriation, therefore, in any way, through faulty metabolism, of the sodic alkali is of serious import. Faulty metabolism also often takes the form of a deficient absorption of fats, and this form is more far-reaching in its effects than is generally recognized. The fats supply the heat or energy which the body demands. Proteids, to be found in all lean meats, cheese, eggs, milk, and vegetables, furnish both energy and tissue-making material. The tendency of the body is to first assimilate heat or

energy for the performance of its functions, and it will draw the necessary amount from the proteids if it have not a sufficient supply of fats, with the result that tissue-building is neglected for want of material. It is therefore important to know this fact, and it is often necessary to see that fats are supplied that they may act as proteid-sparers. The apparently indicated requirement of large quantities of proteids will not fully meet the conditions.

It is not germane to the narrow limits of this paper to specifically consider further the wide range of general pathological disturbances with which the dentist should be familiar because they present the first shadows of their existence within the oral cavity. Sufficient to the occasion is it that indication has been made of the possibility of diagnosis of systemic disturbances through mouth-conditions, and the trend of such familiarity to bring about a most intimate relationship between the dentist and the medical practitioner. Everything at the present hour points to the fact that the future of dentistry lies not in the narrowing confines of developing technique, but in the additional important cultivation of broad medical training.

So true is this fact that the student will have a decided advantage who is fortunate enough to pursue his initial studies of dentistry in institutions connected with medical colleges and hospitals, inasmuch as they can afford him advantages and opportunities for elaborate researches which he cannot obtain in any other way. The atmosphere of medical thought, and the fully equipped physiological and pathological laboratories, lead to investigative action, and must surely produce men who are not likely to lay aside study and research with their day of graduation; and undoubtedly the field of metabolism is sufficiently attractive, and it is to be the connecting link between dental surgery and general medicine.

In conclusion, I wish to give credit to the works of Brubaker, Hare, Pavy, Hofmeister, Porter, Hewlett, Weintraud, and Von Noorden, from whom I have freely drawn in the preparation of this paper.

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